

Effects of GEANT bug fix on
QCD events with high MET

QCD sample

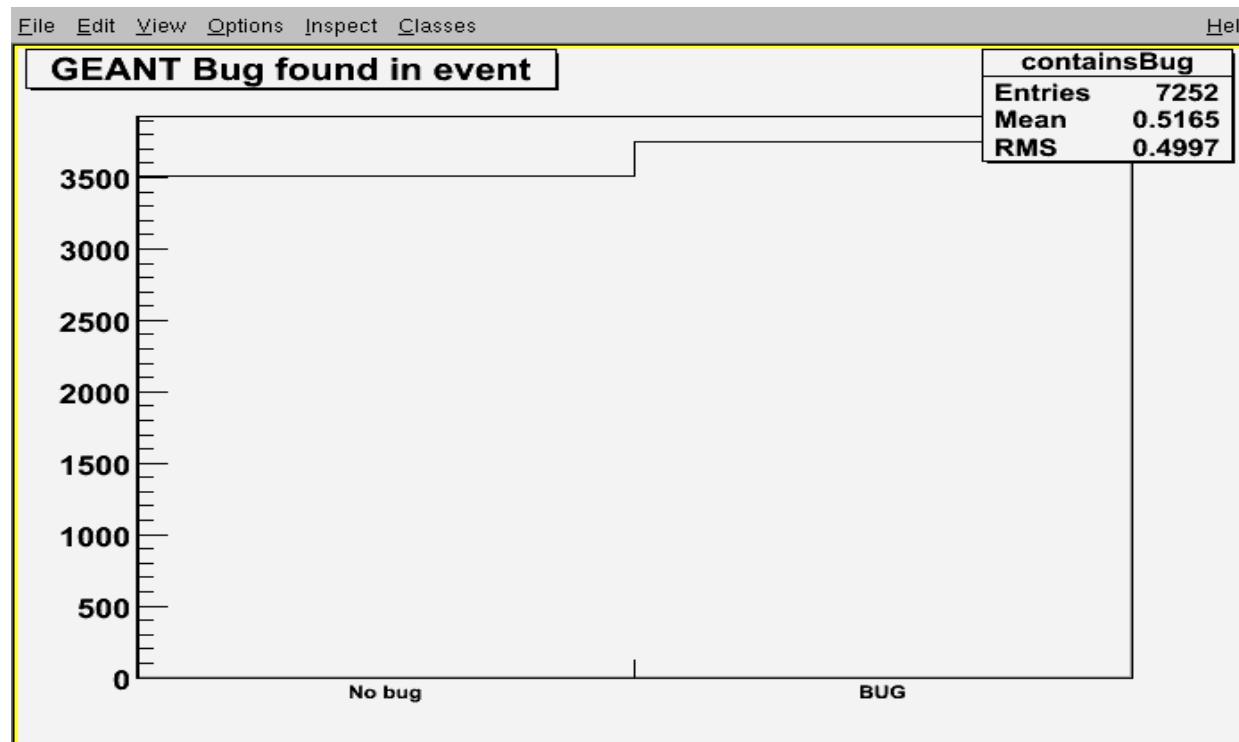
- highMET QCD skim
- genMET < 50 GeV
- MET (w/type 1 corrections) > 150 GeV
- $|\Delta\phi| > 0.35$, $|\Delta(\pi - \phi)| > 0.35$ cut on MET, jet1
- same cut on MET, jet2
- optional additional cut $|\Delta\phi| < 2$ for MET, jet1

GEANT bug

- “spurious disappearance of b- or c- hadrons”
- affects ~1.5% of QCD samples with pt 380-600 GeV
- Suggestion: identify and ignore such events
- In looking at the first 50k events in the highMET sample, 5.4% have this bug prior to any of my selections

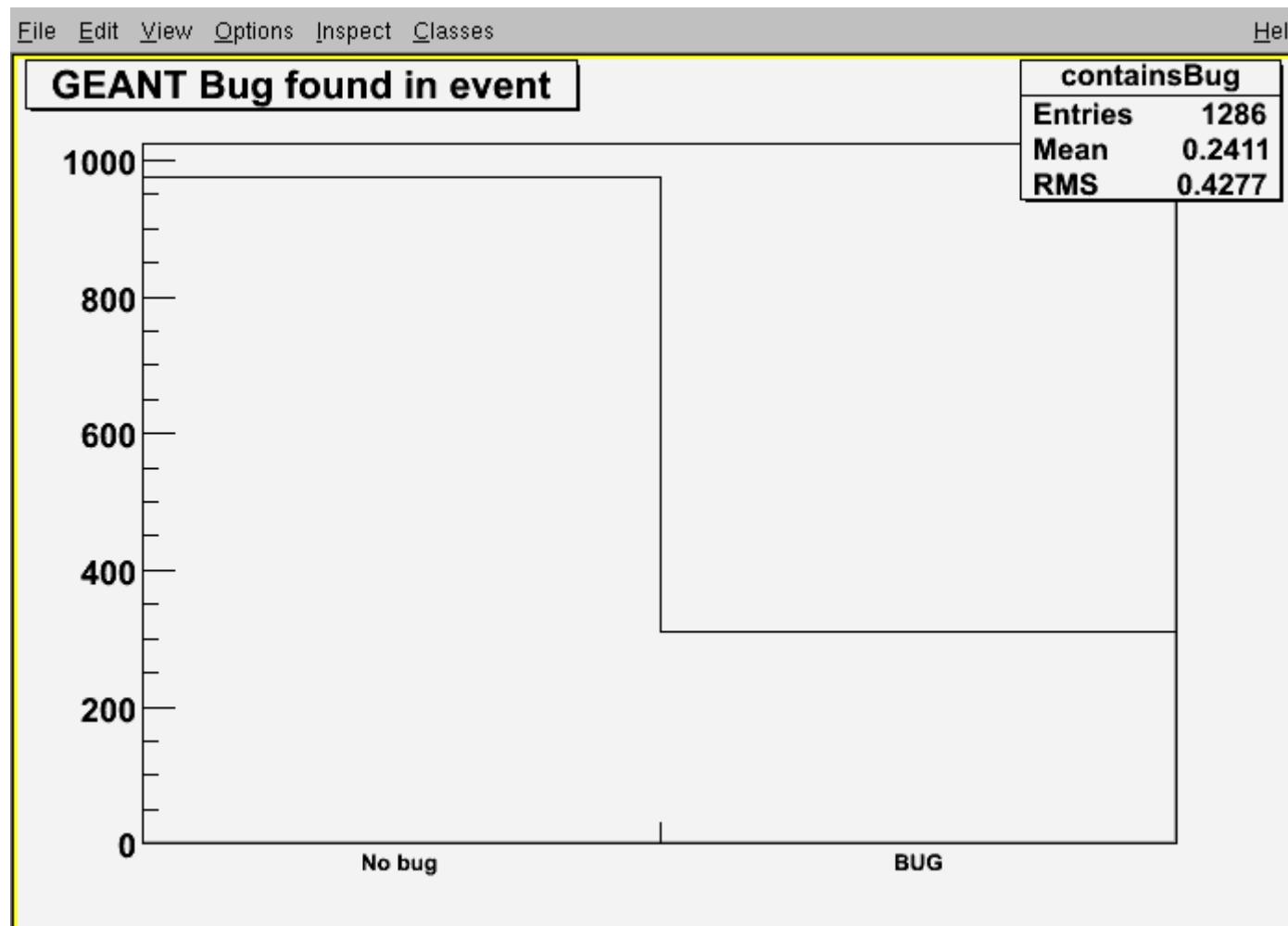
Basic selection

- Results without using additional cut $|\Delta\phi|<2$ on MET, lead jet:



3746/7252 total events have bug!

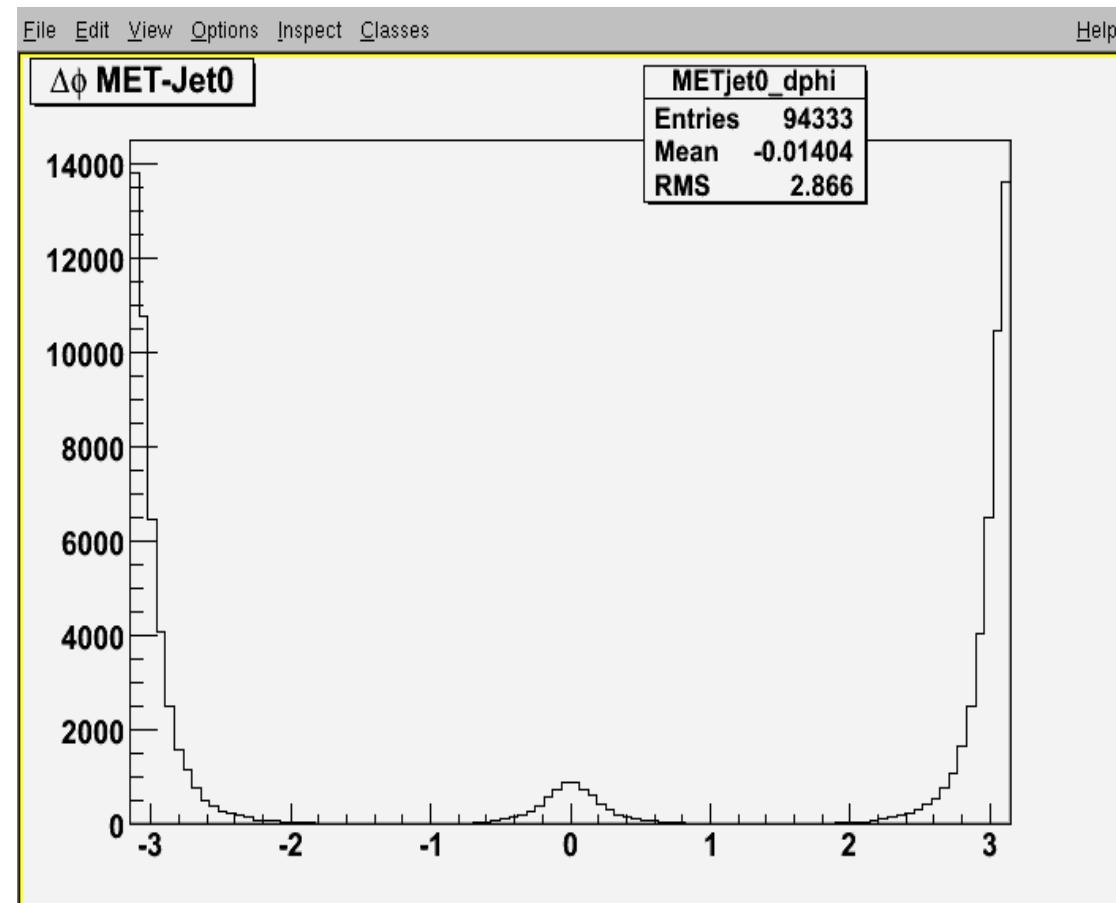
Add $|\Delta\phi| < 2$ cut between MET, lead jet:



- 310/1286 events have bug

Why a lower bug rate with harder cut?

- bug leads to underestimate of jet energy
 - when this happens to lead jet, MET and jet appear more back to back
- $|\Delta\phi| < 2$ cut preferentially reduces these events



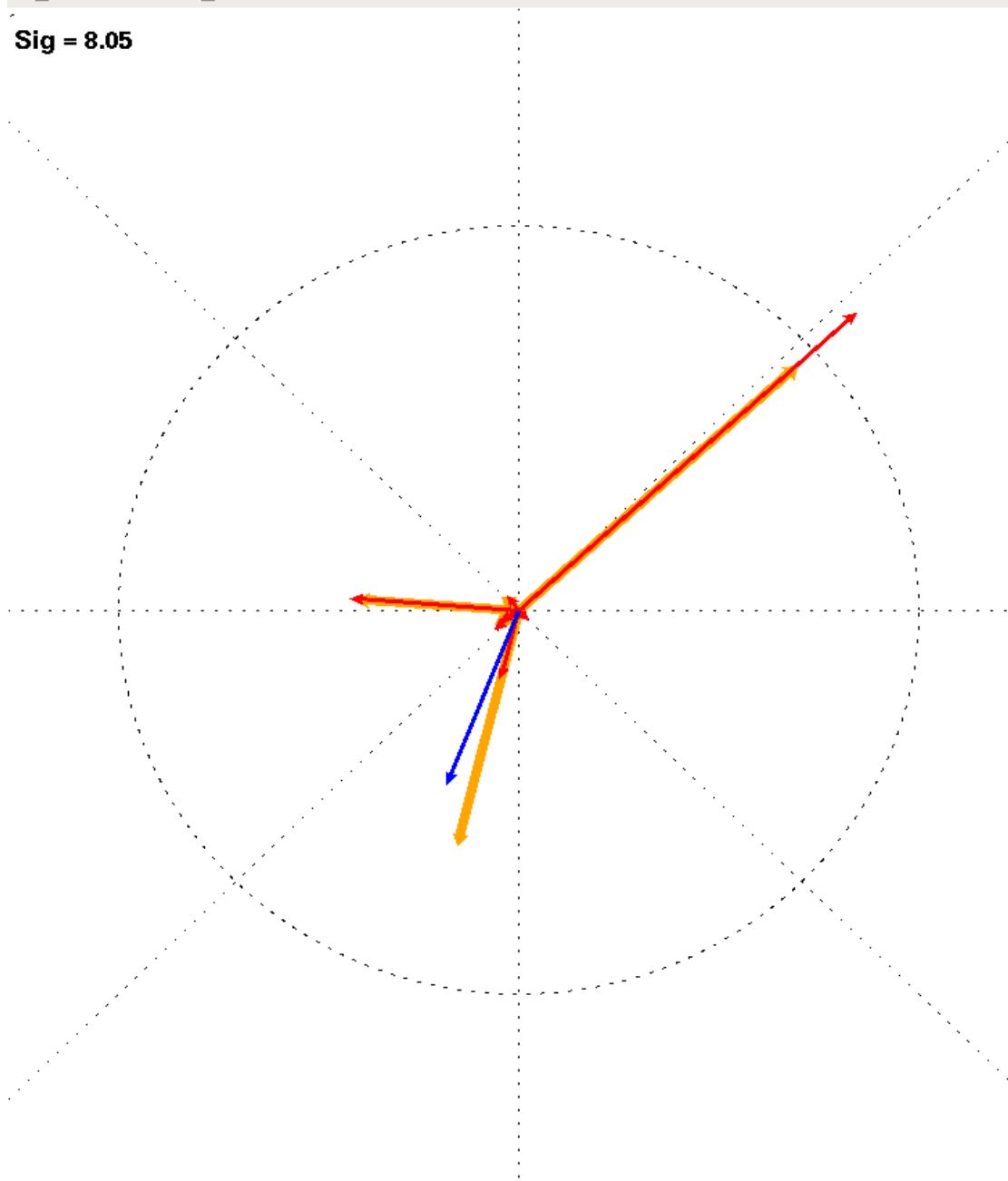
delta phi (MET, lead jet) prior to cuts

Event displays

- Next 10 slides: 1st 10 events that contain the bug
- Note the large disagreement between gen, reco jets in a number of events

Show reco Show gen
 Show gen MET Show reco MET
 Reco vals Gen vals

Sig = 8.05



Gen. Met
ET = 0.5 GeV phi = -0.86

Reco Met
ET = 245.4 GeV phi = -1.94
Uncorr Met
ET = 306.3 GeV phi = -2.12

Gen. Jet	ET	Phi	Eta
472.0	0.74	-0.29	
318.0	-1.81	1.01	
203.5	3.07	1.03	
35.0	-2.57	0.48	
31.0	-2.39	1.33	
28.8	2.46	0.59	

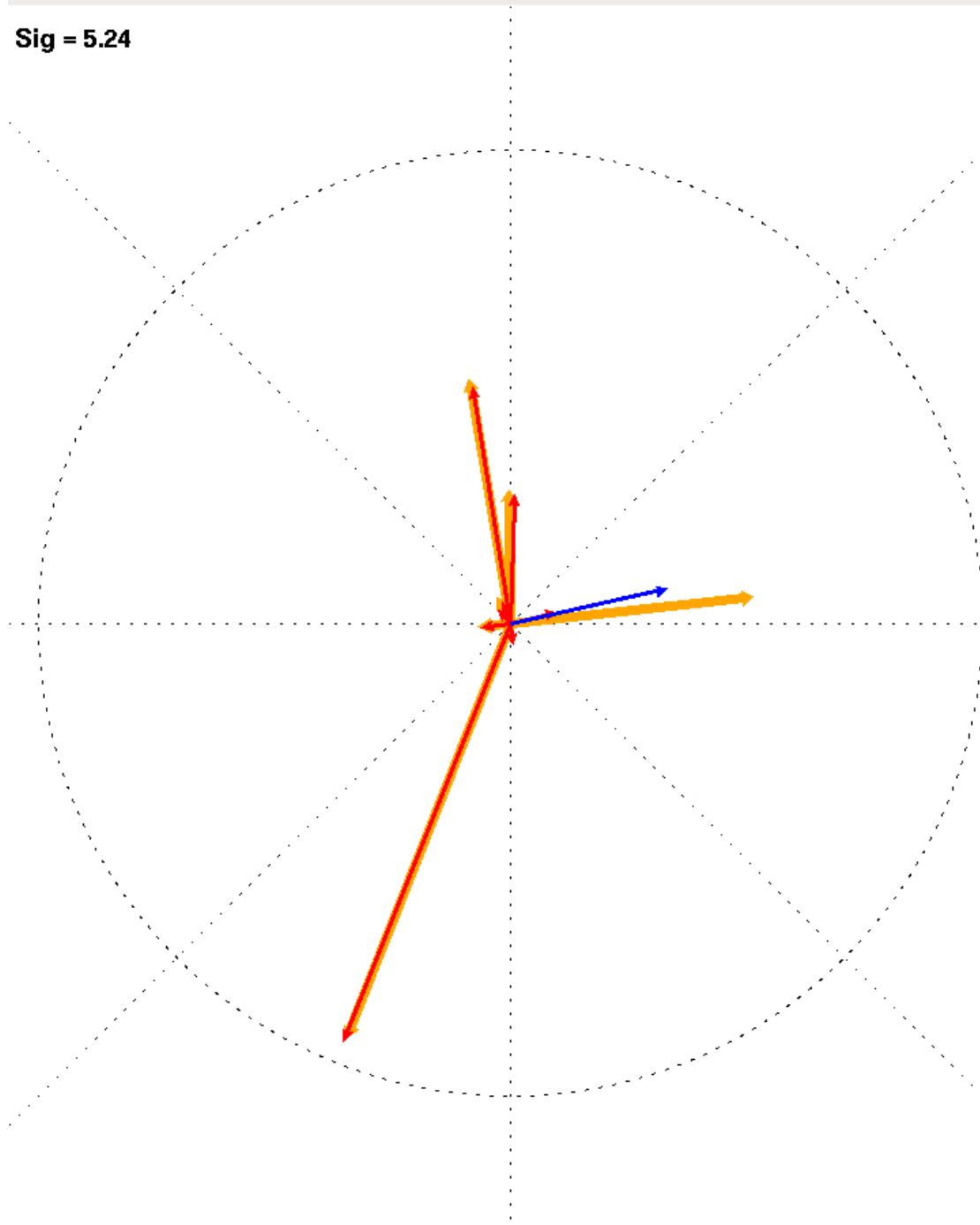
Reco Jet	ET	Phi	Eta
573.9	0.74	-0.31	
211.1	3.07	0.99	
94.5	-1.82	0.96	
41.0	-2.44	1.26	
28.1	-2.55	0.34	
25.0	2.26	0.79	
20.4	-0.80	-0.36	

Prev Event

Next Event

Quit

- Show reco Show gen
- Show gen MET Show reco MET
- Reco vals Gen vals

Sig = 5.24

Gen. Met
ET = 0.3 GeV phi = 0.06

Reco Met
ET = 171.6 GeV phi = 0.22
Uncorr Met
ET = 188.5 GeV phi = 0.53

Gen. Jet	ET	Phi	Eta
472.4	-1.95	2.02	
259.5	0.11	-1.98	
262.6	1.74	0.07	
142.2	1.58	-1.53	
34.1	-3.03	1.59	
31.7	2.05	0.66	

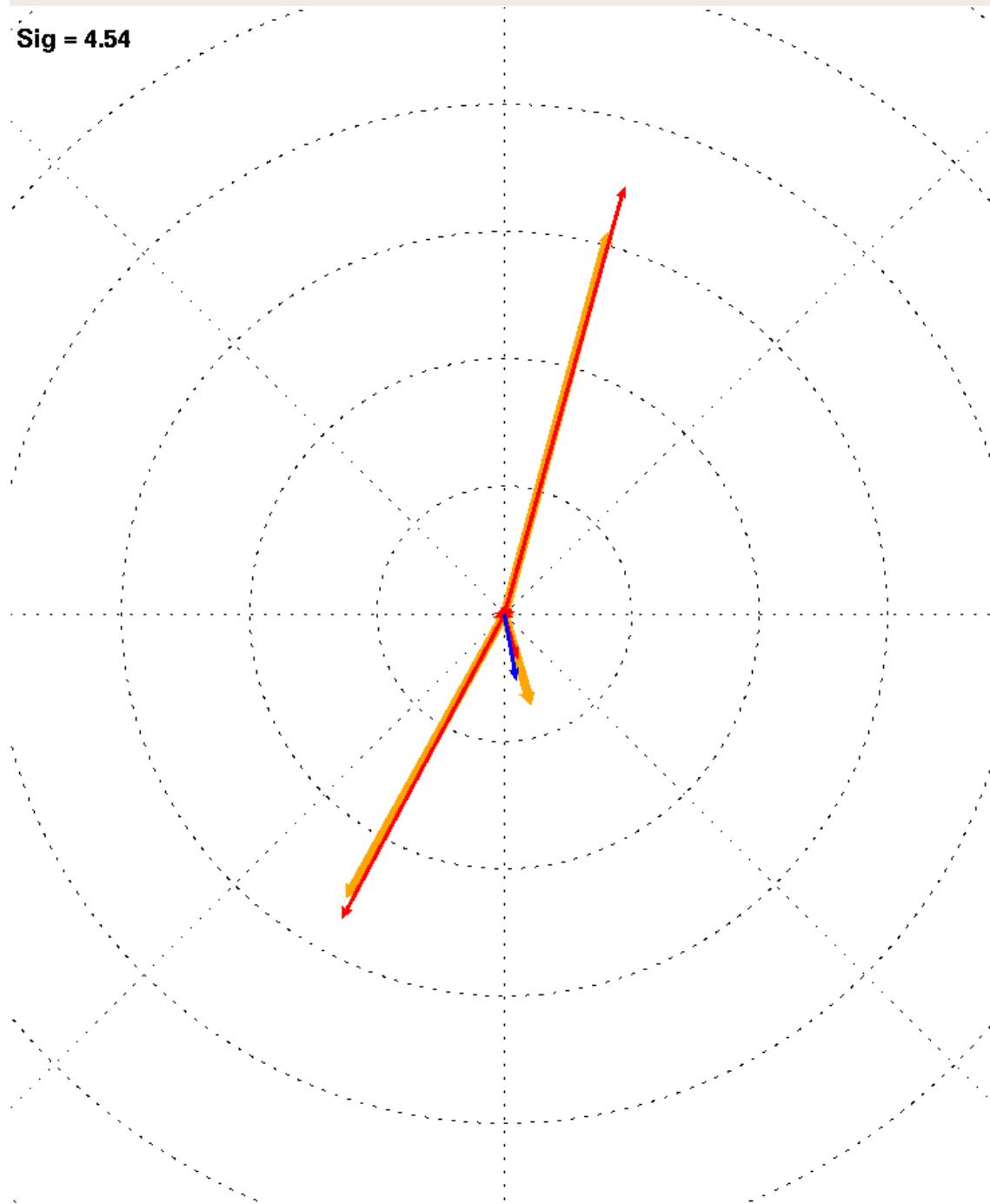
Reco Jet	ET	Phi	Eta
477.9	-1.95	2.01	
254.2	1.73	0.05	
137.1	1.54	-1.56	
51.8	0.22	-2.02	
32.1	-2.99	1.40	
24.9	1.93	0.65	
24.6	-1.46	-0.35	
21.1	2.30	-1.55	

Prev Event

Next Event

Quit

- Show reco Show gen
- Show gen MET Show reco MET
- Reco vals Gen vals

Sig = 4.54

Gen. Met
ET = 0.3 GeV phi = 1.18

Reco Met
ET = 268.9 GeV phi = -1.40
Uncorr Met
ET = 291.4 GeV phi = -1.49

Gen. Jet	ET	Phi	Eta
1556.1	1.31	0.37	
1273.7	-2.08	-1.01	
375.6	-1.29	2.38	
42.5	-2.71	-1.17	
41.8	0.25	0.27	
38.6	-0.24	2.11	
38.5	-0.08	-0.52	

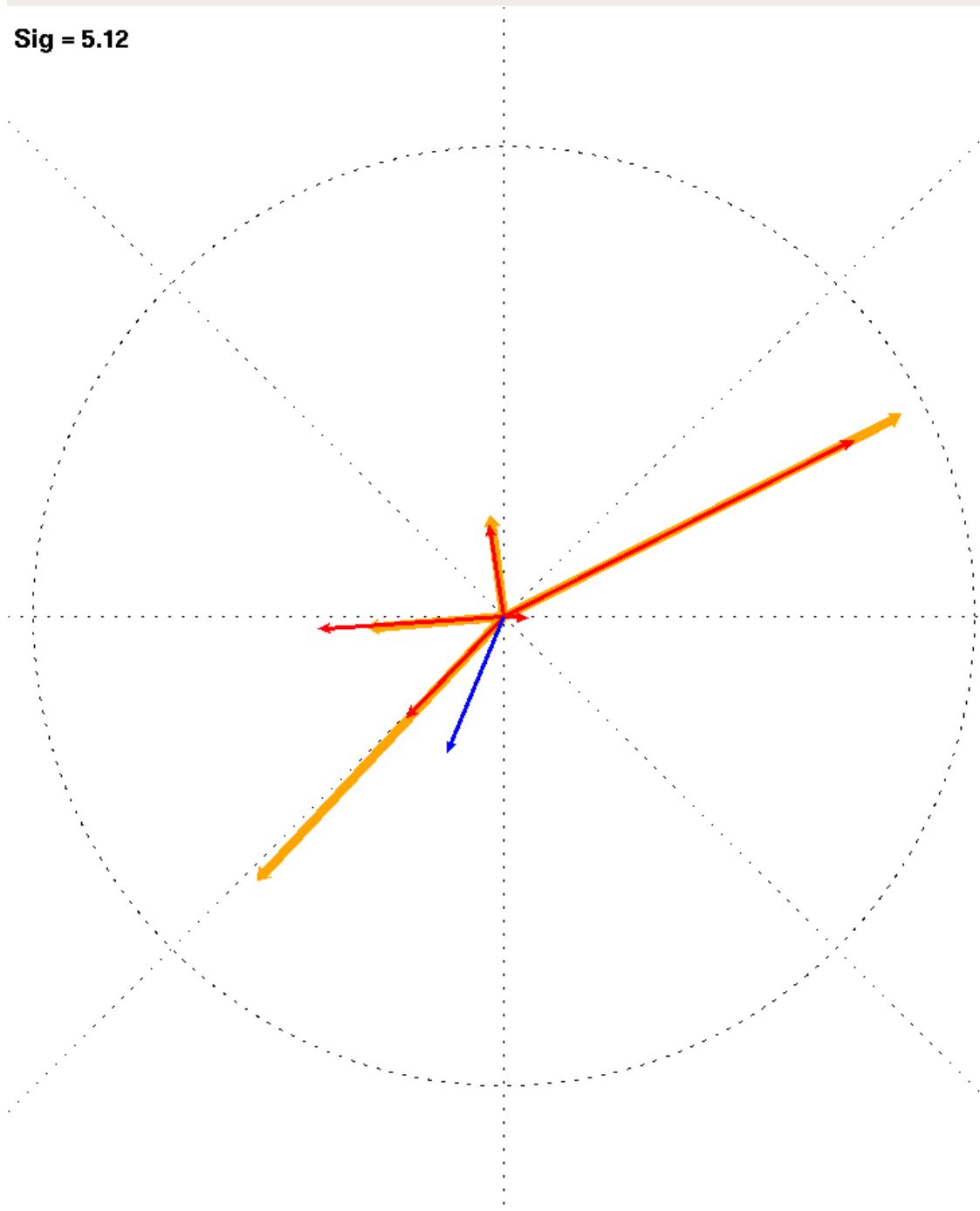
Reco Jet	ET	Phi	Eta
1744.4	1.30	0.39	
1359.2	-2.06	-1.00	
187.3	-1.29	2.40	
43.4	-2.79	-1.05	
42.4	0.23	0.31	
38.6	-0.33	2.16	
29.9	-0.26	-0.39	
26.3	-1.80	0.19	
26.3	0.71	-1.70	
24.8	-0.80	-0.56	

Prev Event

Next Event

Quit

- Show reco Show gen
- Show gen MET Show reco MET
- Reco vals Gen vals

Sig = 5.12

Gen. Met
ET = 4.1 GeV phi = 0.44

Reco Met
ET = 158.6 GeV phi = -1.96
Uncorr Met
ET = 134.3 GeV phi = -2.19

Gen. Jet	ET	Phi	Eta
475.0	0.47	-1.09	
386.2	-2.32	-1.13	
147.1	-3.06	-1.31	
109.3	1.70	0.49	

Reco Jet	ET	Phi	Eta
417.4	0.47	-1.13	
198.6	-3.07	-1.35	
150.8	-2.33	-1.18	
99.7	1.73	0.41	
27.0	-0.06	-1.10	

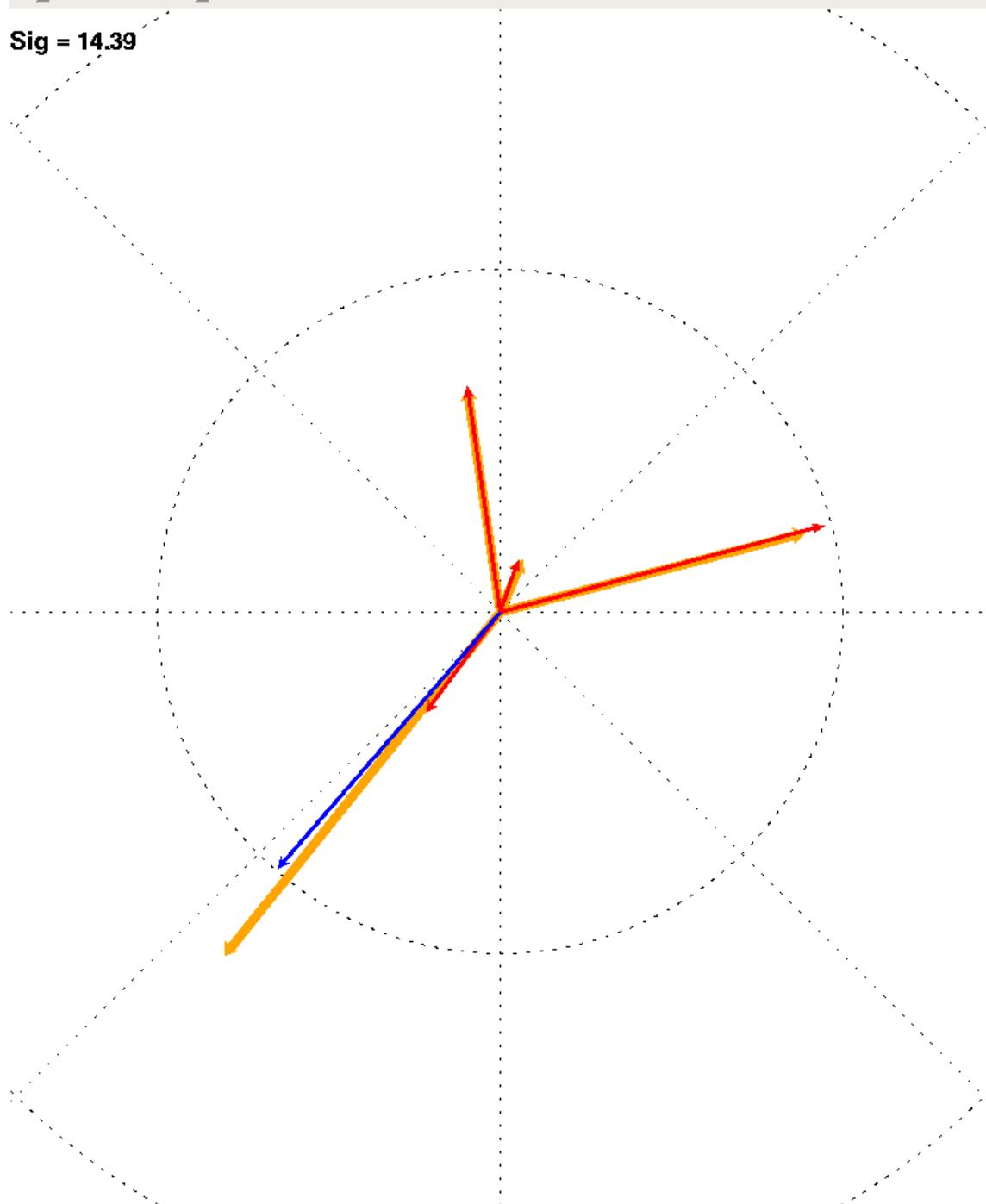
Prev Event

Next Event

Quit

- Show reco Show gen
- Show gen MET Show reco MET
- Reco vals Gen vals

Sig = 14.39



Gen. Met
ET = 1.0 GeV phi = -2.02

Reco Met
ET = 498.0 GeV phi = -2.28
Uncorr Met
ET = 387.8 GeV phi = -2.32

Gen. Jet	ET	Phi	Eta
643.8	-2.25	-1.76	
461.0	0.25	-0.40	
330.8	1.72	0.69	
83.7	1.16	-0.78	

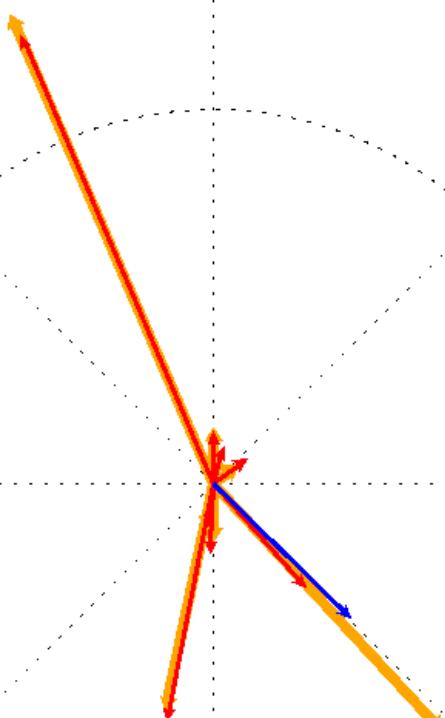
Reco Jet	ET	Phi	Eta
490.6	0.26	-0.39	
334.0	1.71	0.73	
184.2	-2.21	-1.71	
82.1	1.23	-0.78	

Prev Event

Next Event

Quit

Show reco Show gen
 Show gen MET Show reco MET
 Reco vals Gen vals

Sig = 6.64

Gen. Met
ET = 0.8 GeV phi = 2.93

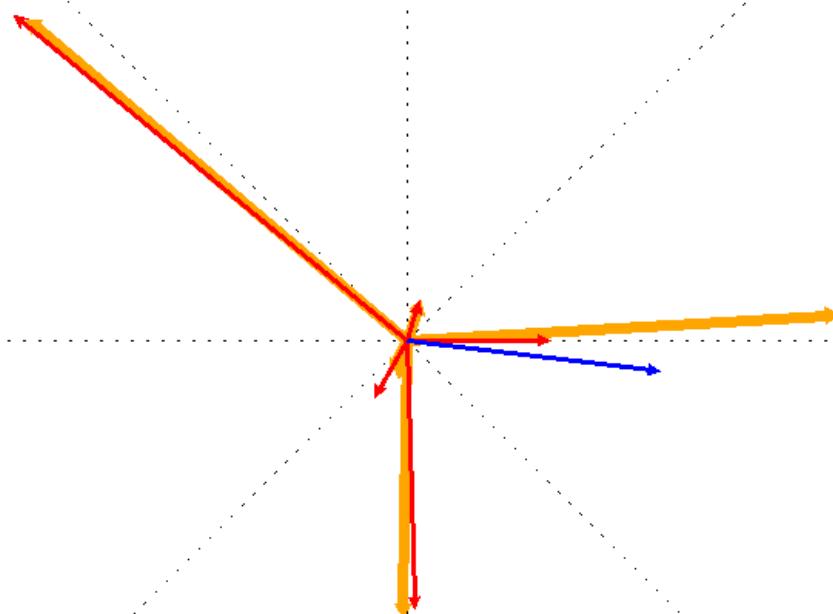
Reco Met
ET = 260.9 GeV phi = -0.78
Uncorr Met
ET = 200.3 GeV phi = -0.88

Gen. Jet	ET	Phi	Eta
684.7	1.98	-1.14	
453.0	-0.83	1.24	
312.8	-1.78	-1.10	
80.2	-1.56	-0.08	
74.4	1.57	1.86	
64.9	-1.72	1.35	
42.1	0.63	3.84	
38.5	1.37	-1.16	

Reco Jet	ET	Phi	Eta
653.0	1.98	-1.16	
327.0	-1.76	-1.10	
188.5	-0.85	1.24	
96.9	-1.62	-0.10	
70.2	1.57	1.86	
61.2	-1.72	1.35	
57.9	0.62	3.77	
52.7	1.30	-1.10	

Show reco Show gen
 Show gen MET Show reco MET
 Reco vals Gen vals

Sig = 5.63



Gen. Met
ET = 0.4 GeV phi = 0.14

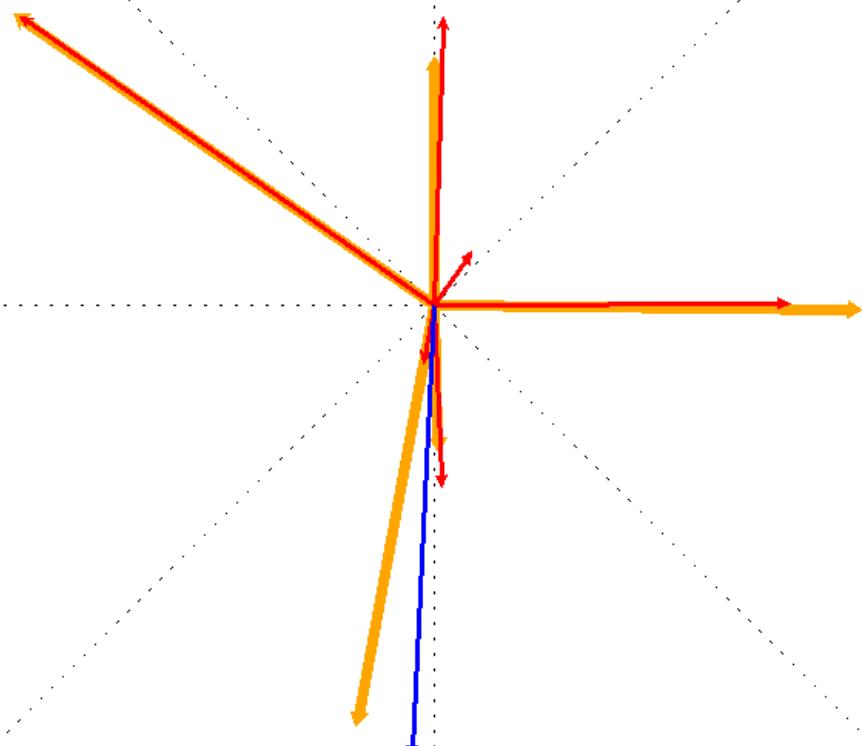
Reco Met
ET = 160.3 GeV phi = -0.12
Uncorr Met
ET = 143.1 GeV phi = -0.13

Gen. Jet	ET	Phi	Eta
312.5	2.44	-0.44	
271.1	0.06	1.75	
173.9	-1.59	-0.73	
27.1	1.23	3.34	
25.2	-1.80	2.51	
23.5	-2.06	-0.97	

Reco Jet	ET	Phi	Eta
320.2	2.45	-0.42	
169.7	-1.54	-0.72	
90.5	-0.01	1.71	
42.6	-2.09	-0.79	
26.4	1.27	3.41	

- Show reco Show gen
- Show gen MET Show reco MET
- Reco vals Gen vals

Sig = 6.06



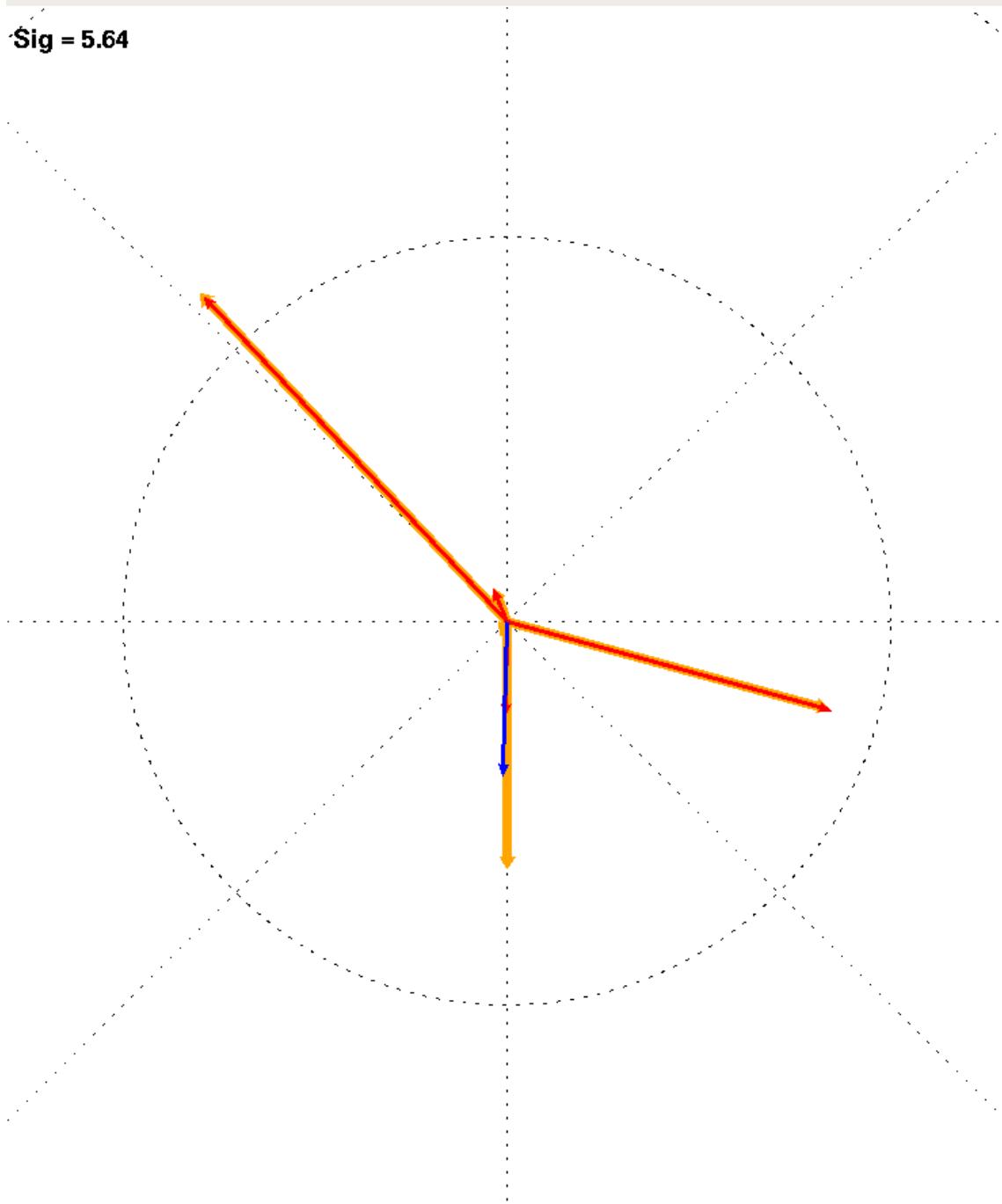
Gen. Met
ET = 0.9 GeV phi = 2.70

Reco Met
ET = 151.1 GeV phi = -1.62
Uncorr Met
ET = 126.4 GeV phi = -1.44

Gen. Jet	ET	Phi	Eta
169.7	2.54	-2.56	
142.4	-1.75	-1.89	
141.9	-0.01	0.48	
82.3	1.57	-3.27	
49.1	-1.54	4.00	

Reco Jet	ET	Phi	Eta
168.1	2.53	-2.54	
118.6	0.00	0.51	
96.1	1.54	-3.24	
61.3	-1.53	3.96	
22.2	0.95	1.06	
20.4	-1.75	-1.86	

- Show reco Show gen
- Show gen MET Show reco MET
- Reco vals Gen vals

Sig = 5.64

Gen. Met
ET = 0.1 GeV phi = -0.09

Reco Met
ET = 203.3 GeV phi = -1.60
Uncorr Met
ET = 162.7 GeV phi = -1.95

Gen. Jet	ET	Phi	Eta
586.3	2.32	1.24	
436.1	-0.27	-2.09	
323.8	-1.57	1.51	
47.3	1.96	0.63	
21.5	-1.96	-2.30	

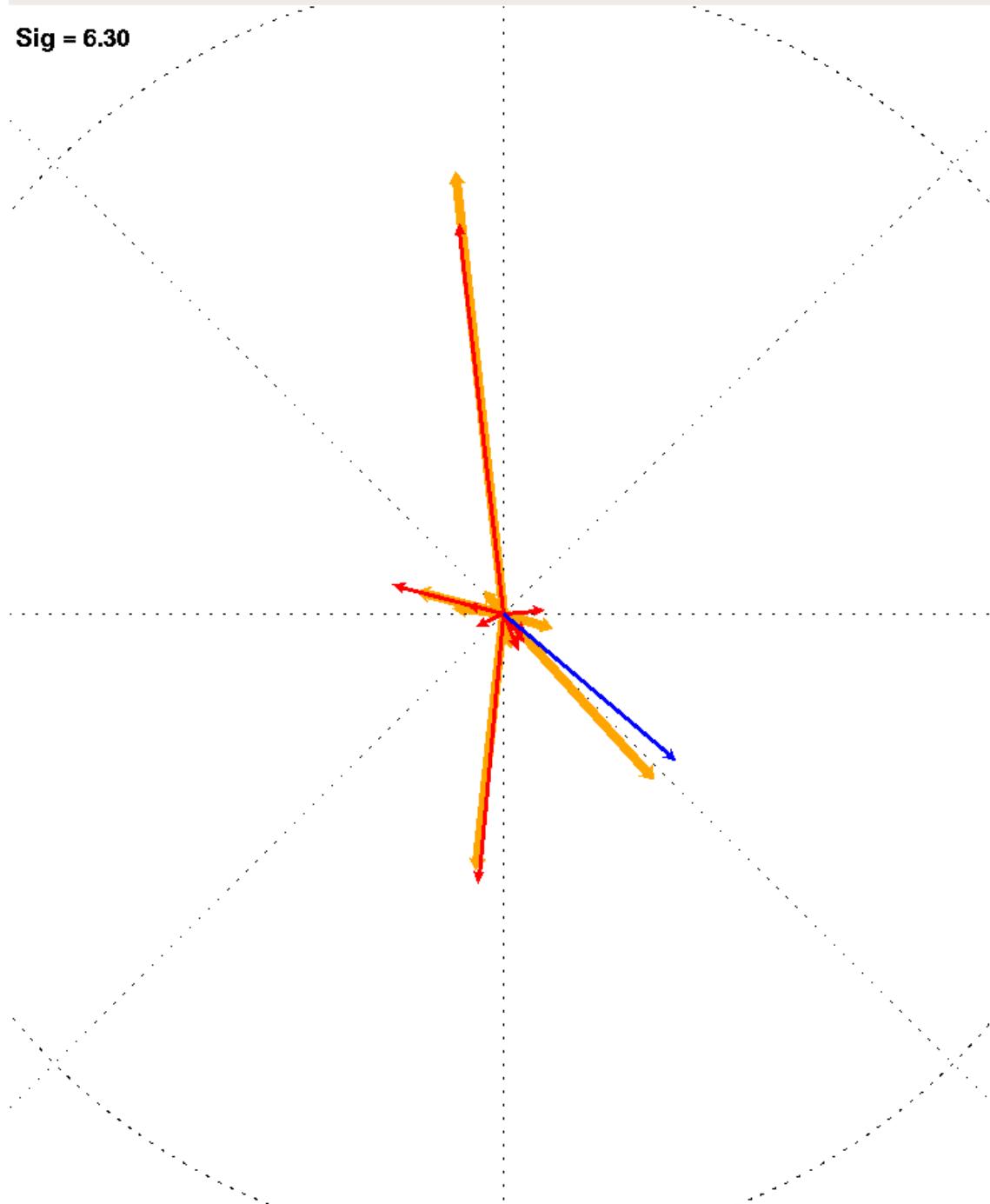
Reco Jet	ET	Phi	Eta
579.7	2.32	1.24	
439.3	-0.27	-2.11	
125.1	-1.58	1.46	
45.9	1.96	0.63	

Prev Event

Next Event

Quit

Show reco Show gen
 Show gen MET Show reco MET
 Reco vals Gen vals

Sig = 6.30

Gen. Met
ET = 46.0 GeV phi = -0.87

Reco Met
ET = 179.3 GeV phi = -0.71
Uncorr Met
ET = 156.8 GeV phi = -0.91

Gen. Jet	ET	Phi	Eta
349.7	1.68	-1.78	
203.9	-1.68	-0.84	
176.7	-0.84	-1.81	
70.1	2.90	-2.03	
41.1	-0.31	1.67	
39.7	3.04	-0.40	
28.1	-1.36	0.93	
23.9	2.28	-1.34	

Reco Jet	ET	Phi	Eta
308.9	1.69	-1.77	
214.0	-1.66	-0.83	
90.3	2.89	-2.01	
33.1	0.08	1.57	
32.2	-1.18	0.87	
29.5	-0.95	-1.83	
29.9	2.90	-0.35	
24.8	-0.72	1.76	
24.9	-2.70	-0.03	

Prev Event

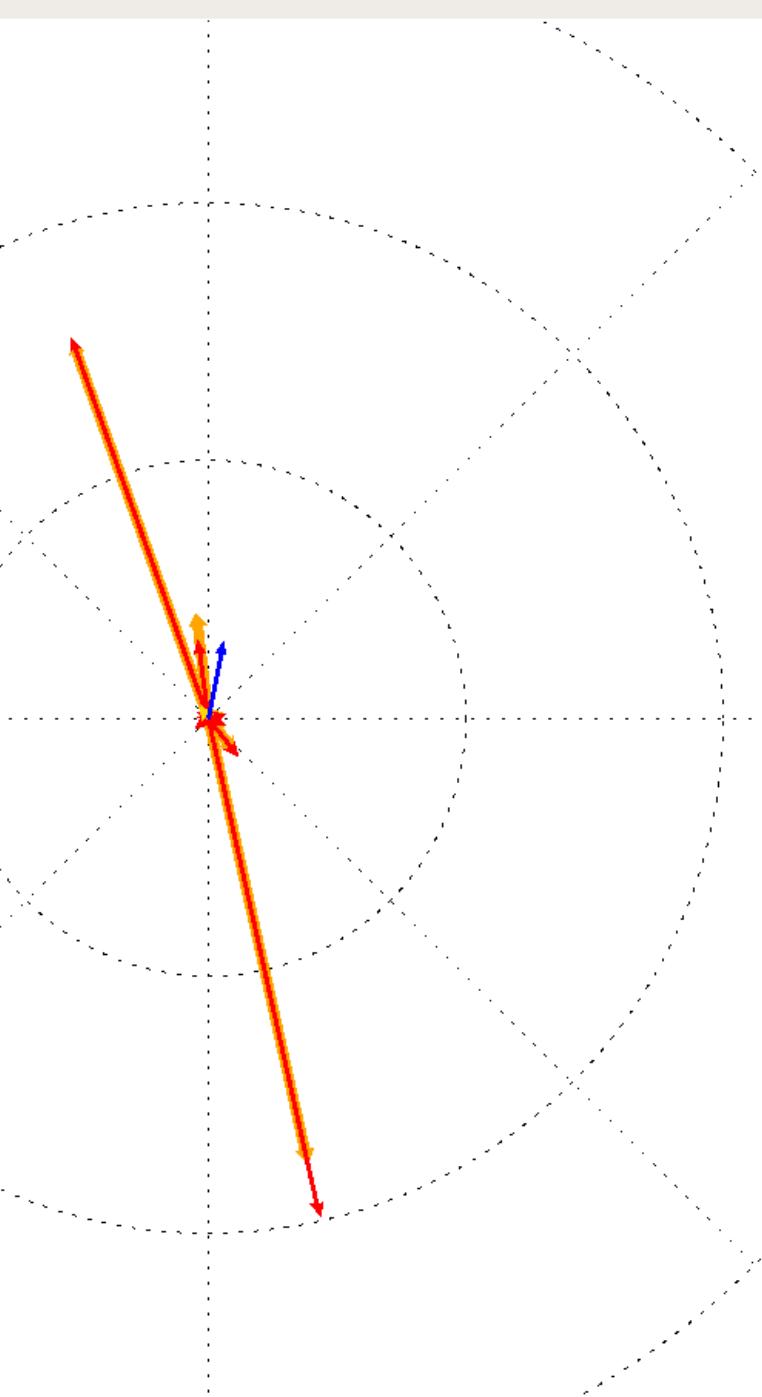
Next Event

Quit

More event displays

- next 10 slides: First 10 events without bug
- Tend not to see single poorly-reconstructed jets
- Do see extra jets, small mismeasurements of large-ET jets leading to significant MET

- Show reco Show gen
- Show gen MET Show reco MET
- Reco vals Gen vals

Sig = 3.21

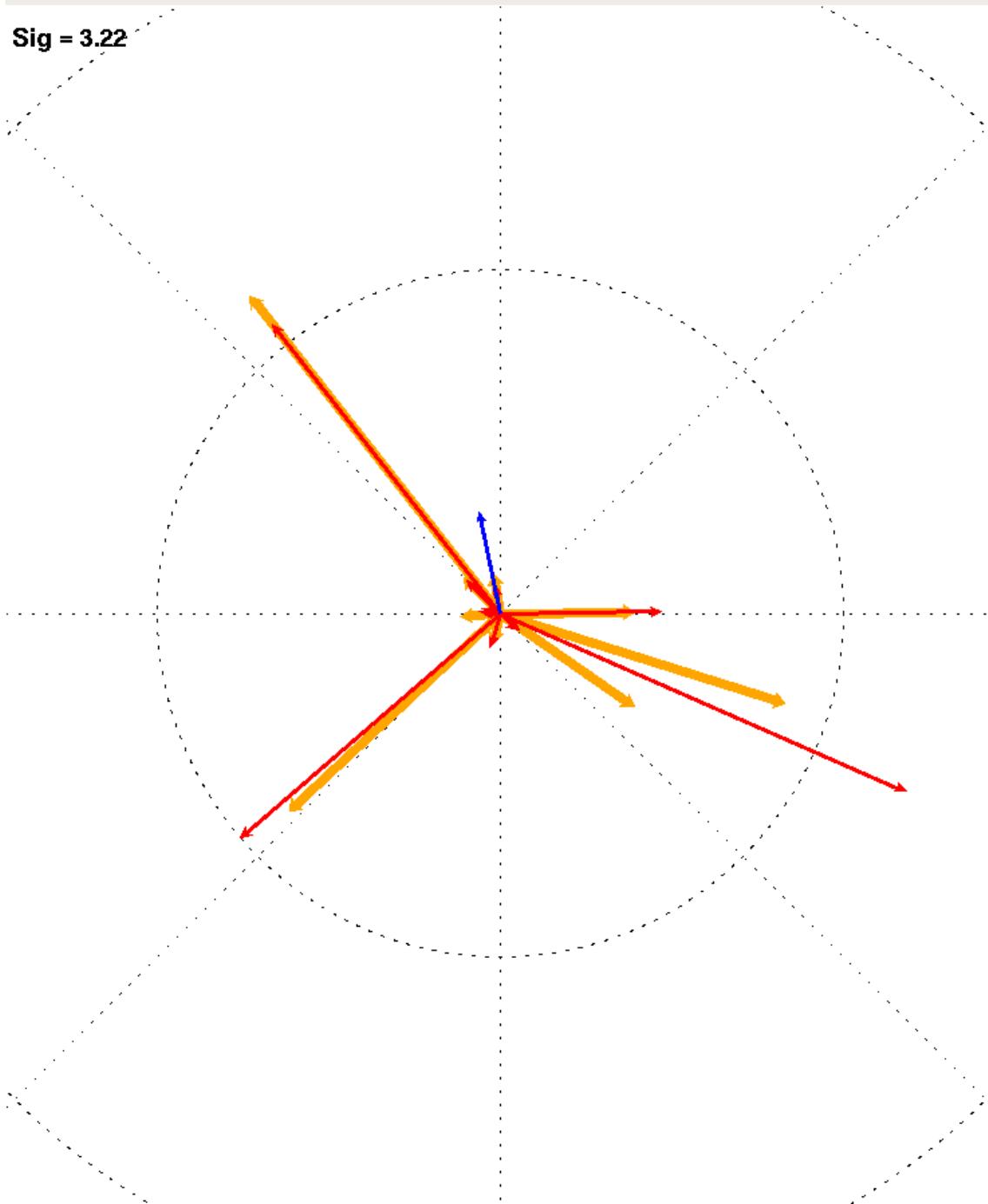
Gen. Met ET = 1.0 GeV phi = -2.76			
Reco Met ET = 154.7 GeV phi = 1.38 Uncorr Met ET = 159.0 GeV phi = 1.36			
Gen. Jet	ET	Phi	Eta
886.6	-1.35	0.69	
778.6	1.92	-1.44	
207.1	1.68	-0.24	
84.6	-0.91	1.03	
36.3	0.20	1.19	
37.4	-0.46	-0.12	
25.4	-2.52	4.43	
20.5	2.64	-2.87	
Reco Jet	ET	Phi	Eta
993.3	-1.35	0.66	
786.7	1.92	-1.44	
154.3	1.71	-0.23	
96.0	-0.90	1.01	
37.6	0.17	1.16	
38.0	-0.37	-0.09	
35.2	-2.49	1.72	
26.1	2.63	-2.84	
24.1	2.54	-1.30	
22.9	-2.57	4.36	
20.9	2.53	-2.22	
20.8	3.03	1.21	
Reco Electron	ET	Phi	Eta
29.7	2.21	-1.30	
29.0	2.15	-1.32	

Prev Event

Next Event

Quit

- Show reco Show gen
- Show gen MET Show reco MET
- Reco vals Gen vals

Sig = 3.22

Gen. Met
ET = 1.7 GeV phi = -1.82

Reco Met
ET = 153.3 GeV phi = 1.78
Uncorr Met
ET = 116.4 GeV phi = 1.76

Gen. Jet	ET	Phi	Eta
590.4	2.24	-0.54	
436.8	-0.31	0.56	
423.3	-2.39	-0.96	
239.3	-0.61	0.08	
196.6	0.01	-1.15	
77.4	2.37	-2.51	
60.0	1.74	1.09	
59.0	-3.07	-1.44	
47.7	-1.83	-2.35	

Reco Jet	ET	Phi	Eta
647.5	-0.41	0.42	
537.4	2.24	-0.52	
502.7	-2.43	-0.95	
236.9	0.01	-1.15	
70.8	2.37	-2.51	
54.5	-1.86	-2.40	
44.3	1.73	1.07	
39.4	-0.76	-0.04	
30.7	3.07	-1.58	
27.7	2.90	-0.45	

Prev Event

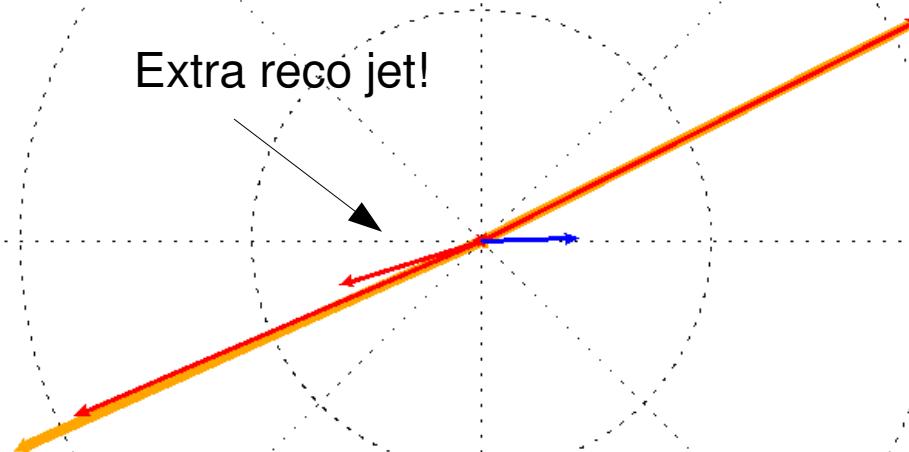
Next Event

Quit

- Show reco Show gen
- Show gen MET Show reco MET
- Reco vals Gen vals

Sig = 4.28

Extra reco jet!



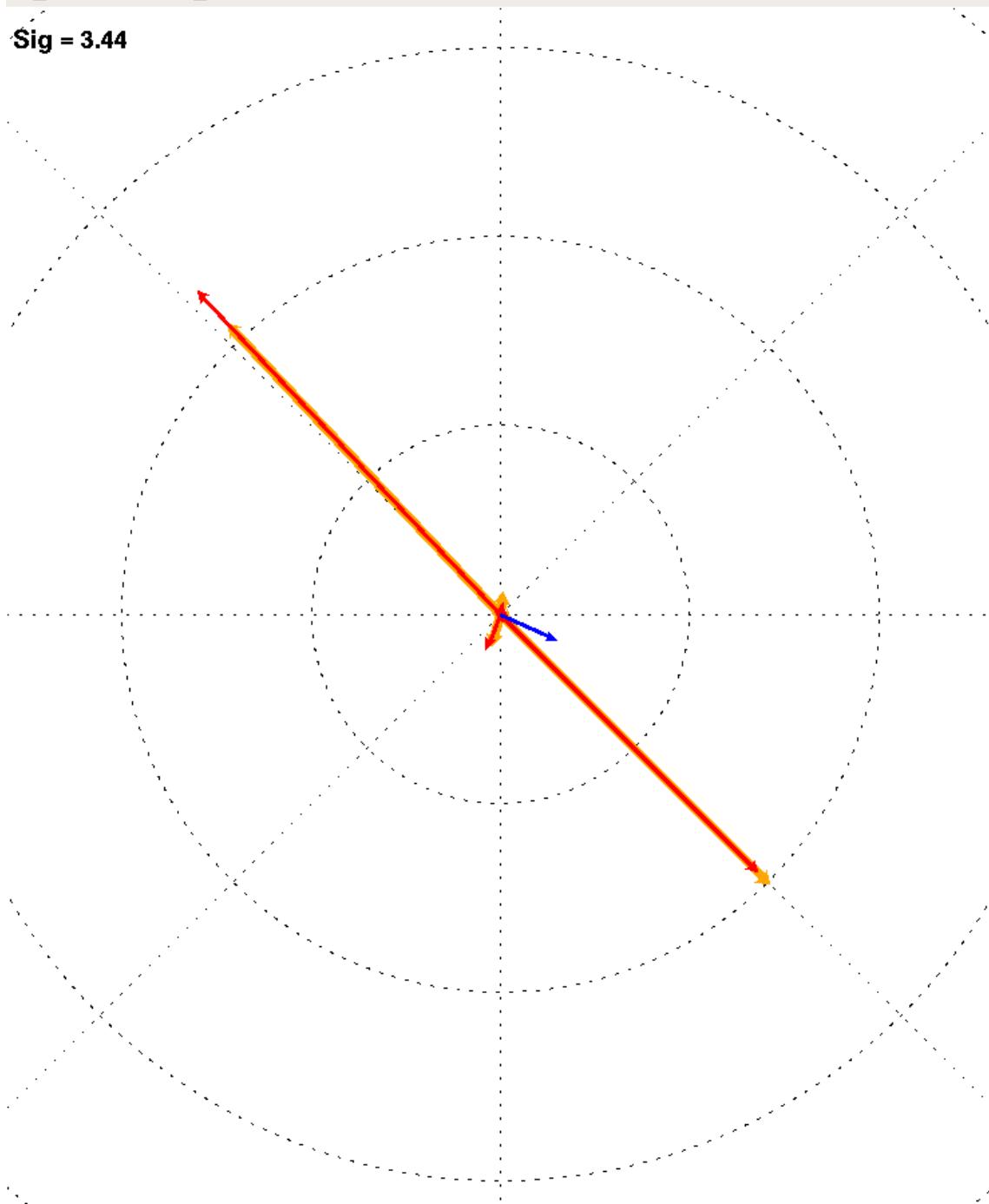
Gen. Met
ET = 2.1 GeV phi = -3.12

Reco Met
ET = 212.8 GeV phi = 0.02
Uncorr Met
ET = 136.9 GeV phi = -0.07

Gen. Jet	ET	Phi	Eta
	1112.5	-2.72	1.11
	1086.5	0.47	1.30
	23.8	-0.82	-1.50

Reco Jet	ET	Phi	Eta
	1073.9	0.47	1.31
	962.1	-2.73	1.11
	323.9	-2.84	0.50
	23.9	0.96	1.58
	22.1	0.04	1.66

- Show reco Show gen
- Show gen MET Show reco MET
- Reco vals Gen vals

Sig = 3.44

Gen. Met
ET = 24.3 GeV phi = 1.33

Reco Met
ET = 170.3 GeV phi = -0.44
Uncorr Met
ET = 247.9 GeV phi = -0.69

Gen. Jet	ET	Phi	Eta
1056.1	2.33	-1.53	
1012.5	-0.79	0.03	
91.1	-1.85	0.55	
61.2	1.43	-0.23	
40.0	-0.63	0.77	
28.1	-1.45	-0.04	

Reco Jet	ET	Phi	Eta
1175.4	2.32	-1.52	
969.8	-0.79	0.03	
103.7	-1.94	0.55	
40.4	-0.72	0.78	
33.9	1.34	-0.21	
23.3	-1.44	-0.13	

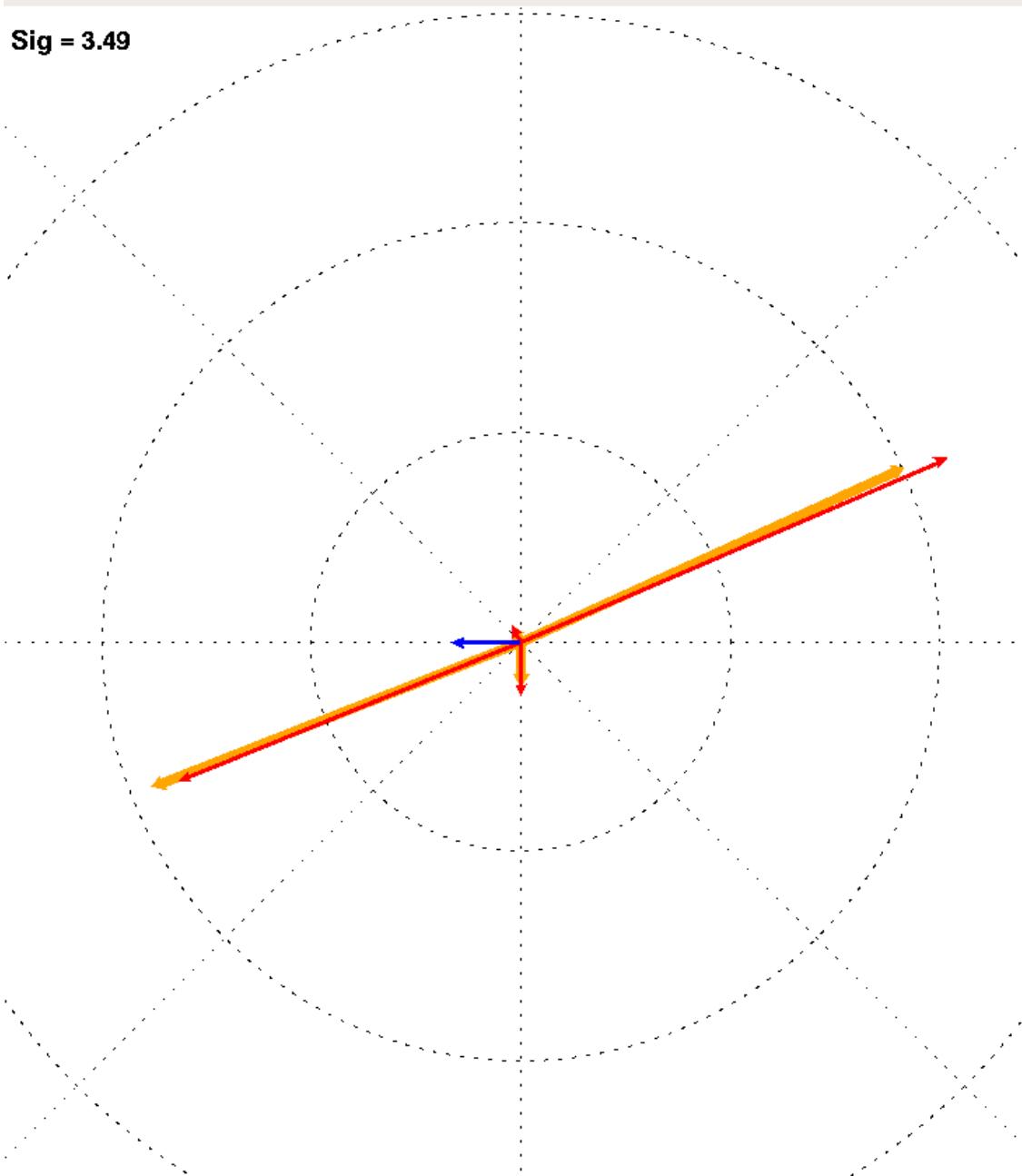
Prev Event

Next Event

Quit

Show reco Show gen
 Show gen MET Show reco MET
 Reco vals Gen vals

Sig = 3.49



Gen. Met
ET = 0.8 GeV phi = -0.41

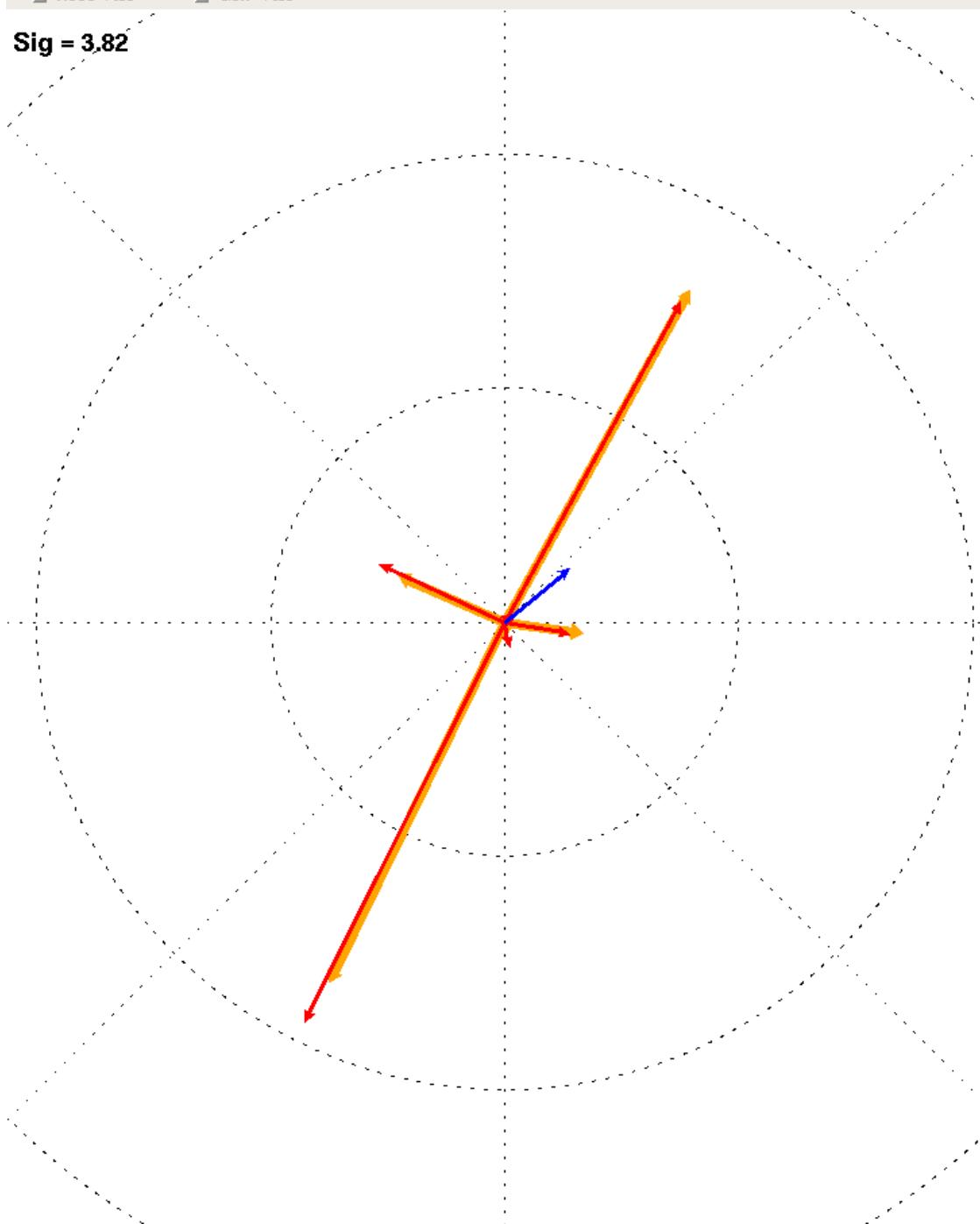
Reco Met
ET = 166.7 GeV phi = -3.13
Uncorr Met
ET = 160.9 GeV phi = -3.04

Gen. Jet	ET	Phi	Eta
1007.2	0.43	0.38	
948.3	-2.77	0.12	
107.5	-1.56	0.86	
43.0	2.08	1.38	

Reco Jet	ET	Phi	Eta
1110.2	0.41	0.38	
884.0	-2.75	0.10	
133.7	-1.56	0.85	
47.3	2.13	1.37	

- Show reco Show gen
- Show gen MET Show reco MET
- Reco vals Gen vals

Sig = 3.82



Gen. Met
ET = 0.4 GeV phi = 3.05

Reco Met
ET = 184.2 GeV phi = 0.69
Uncorr Met
ET = 140.3 GeV phi = 0.57

Gen. Jet	ET	Phi	Eta
859.0	-2.02	0.98	
813.4	1.06	0.11	
249.3	2.73	0.43	
170.7	-0.14	-0.58	
34.1	-1.45	1.03	

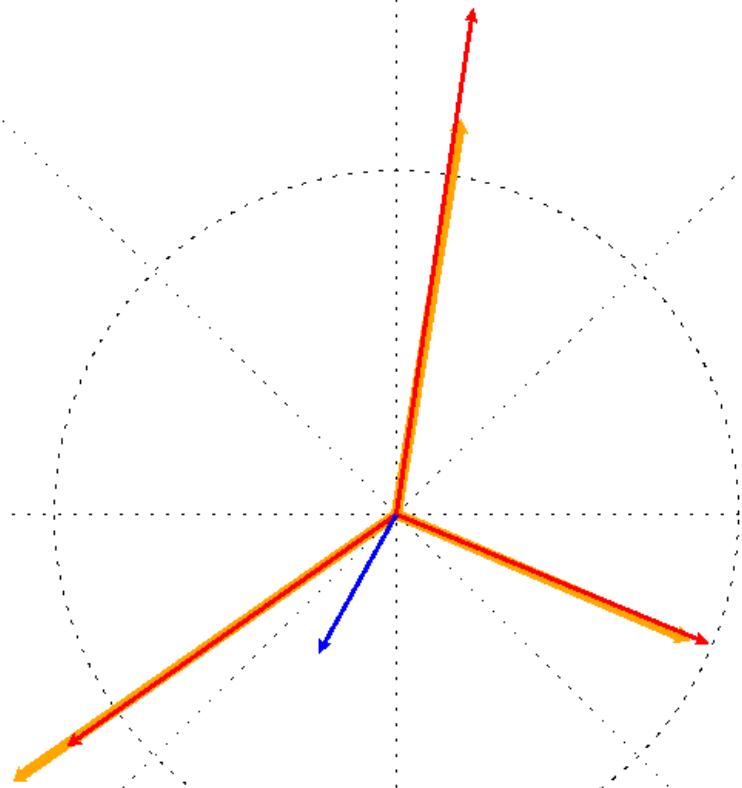
Reco Jet	ET	Phi	Eta
957.9	-2.03	0.92	
783.5	1.07	0.05	
295.8	2.71	0.39	
145.0	-0.18	-0.58	
58.5	-1.40	0.94	
32.1	0.64	-1.14	
26.1	0.48	-0.17	

Prev Event

Next Event

Quit

- Show reco Show gen
- Show gen MET Show reco MET
- Reco vals Gen vals

Sig = 5.33

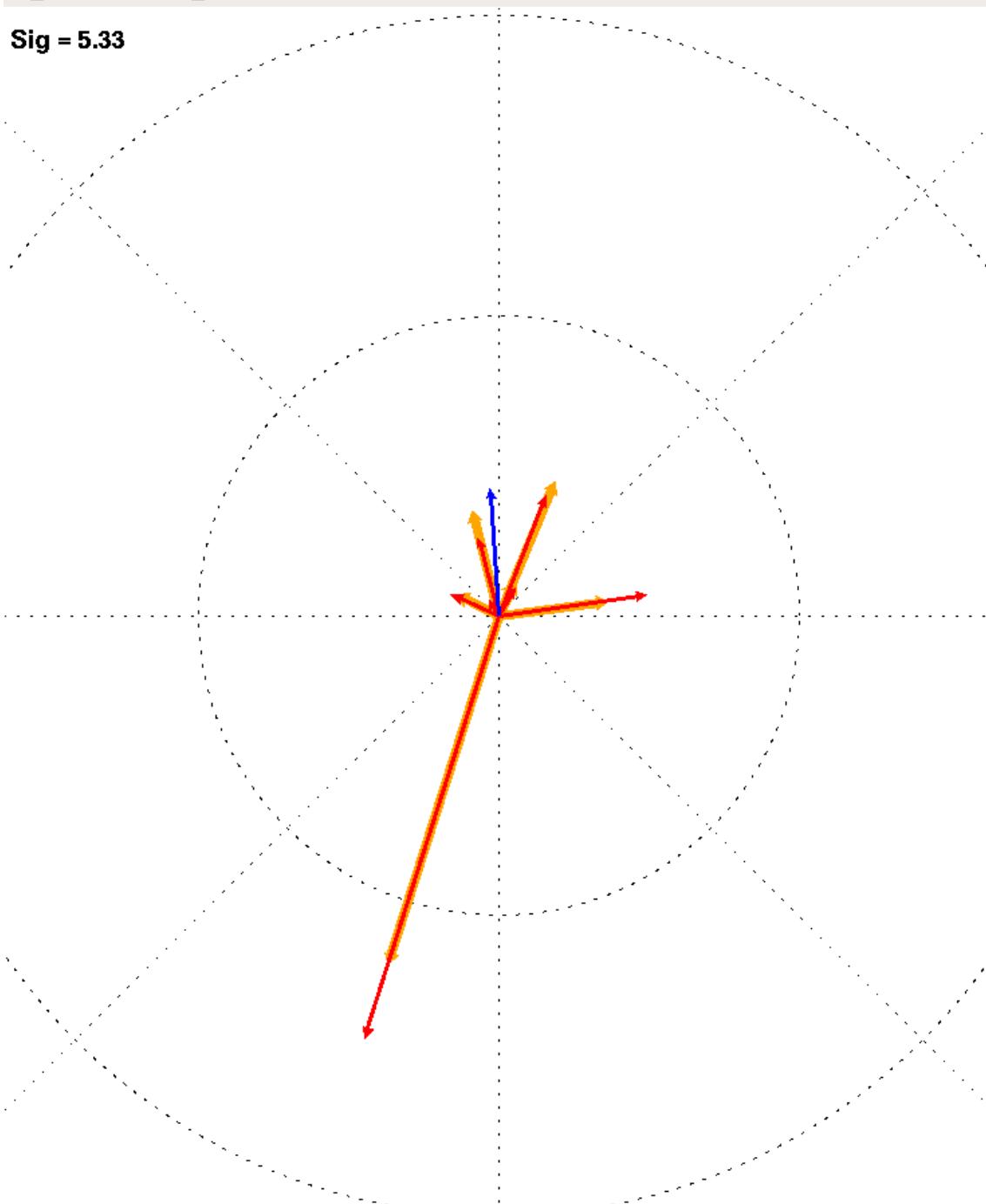
Gen. Met
ET = 0.8 GeV phi = 2.14

Reco Met
ET = 235.1 GeV phi = -2.08
Uncorr Met
ET = 186.6 GeV phi = -2.04

Gen. Jet	ET	Phi	Eta
684.1	-2.53	-0.60	
584.4	1.41	1.01	
466.9	-0.41	-0.94	

Reco Jet	ET	Phi	Eta
746.4	1.42	1.00	
589.4	-2.53	-0.59	
495.1	-0.40	-0.95	

- Show reco Show gen
- Show gen MET Show reco MET
- Reco vals Gen vals

Sig = 5.33

Gen. Met
ET = 26.2 GeV phi = 1.10

Reco Met
ET = 214.8 GeV phi = 1.64
Uncorr Met
ET = 300.5 GeV phi = 1.48

Gen. Jet	ET	Phi	Eta
612.0	-1.88	1.50	
243.1	1.17	0.98	
184.9	0.13	-1.10	
181.7	1.82	0.25	
78.9	2.68	-1.35	
62.7	1.11	-0.11	
31.0	1.72	-0.52	
23.0	2.03	0.90	

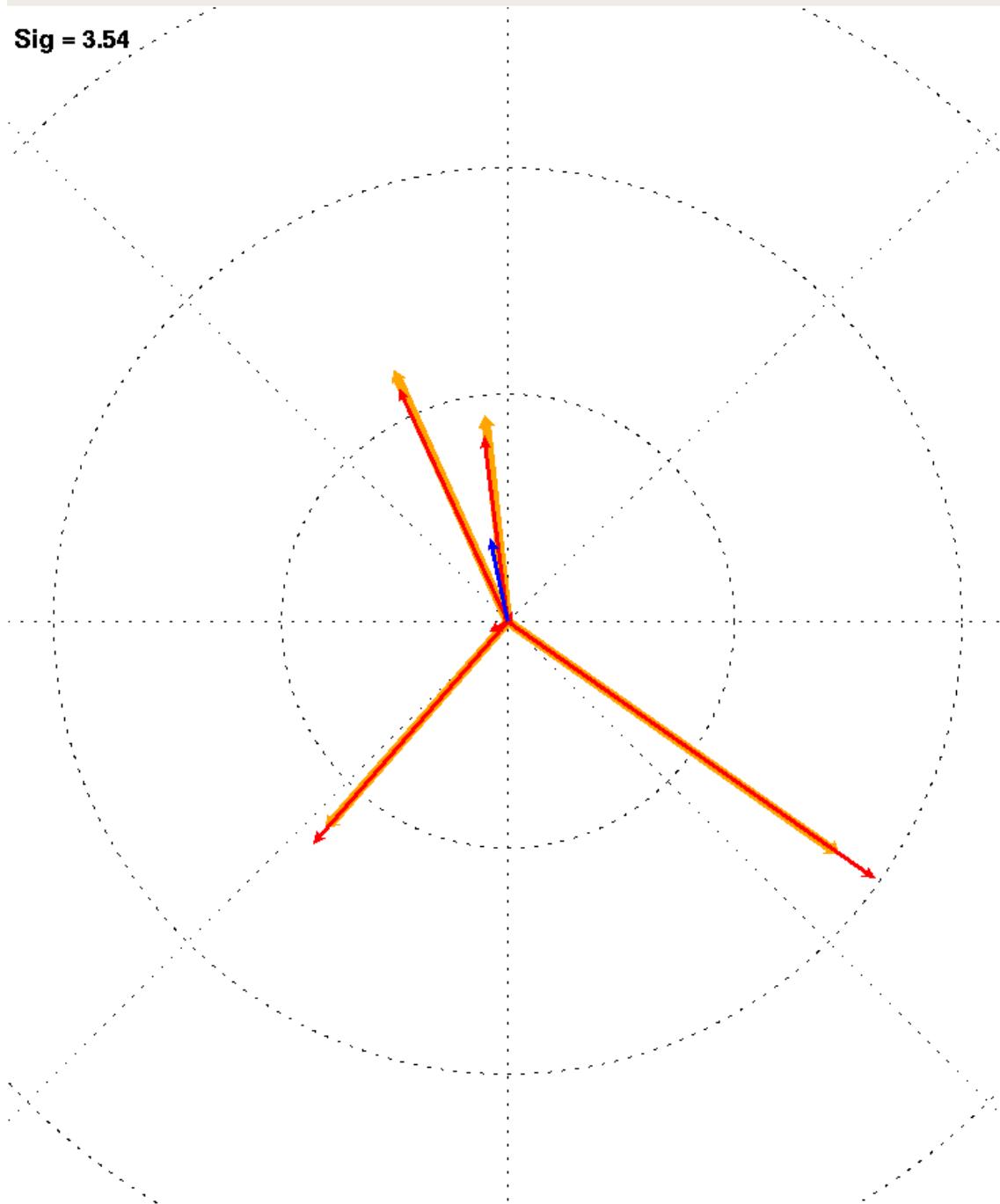
Reco Jet	ET	Phi	Eta
742.3	-1.88	1.51	
251.2	0.14	-1.10	
217.0	1.20	0.97	
136.2	1.83	0.16	
87.3	2.73	-1.35	
56.5	1.05	-0.07	
33.5	2.16	0.82	
28.6	1.79	-0.46	

Prev Event

Next Event

Quit

- Show reco Show gen
- Show gen MET Show reco MET
- Reco vals Gen vals

Sig = 3.54

Gen. Met
ET = 1.4 GeV phi = -1.12

Reco Met
ET = 187.4 GeV phi = 1.78
Uncorr Met
ET = 202.9 GeV phi = 1.72

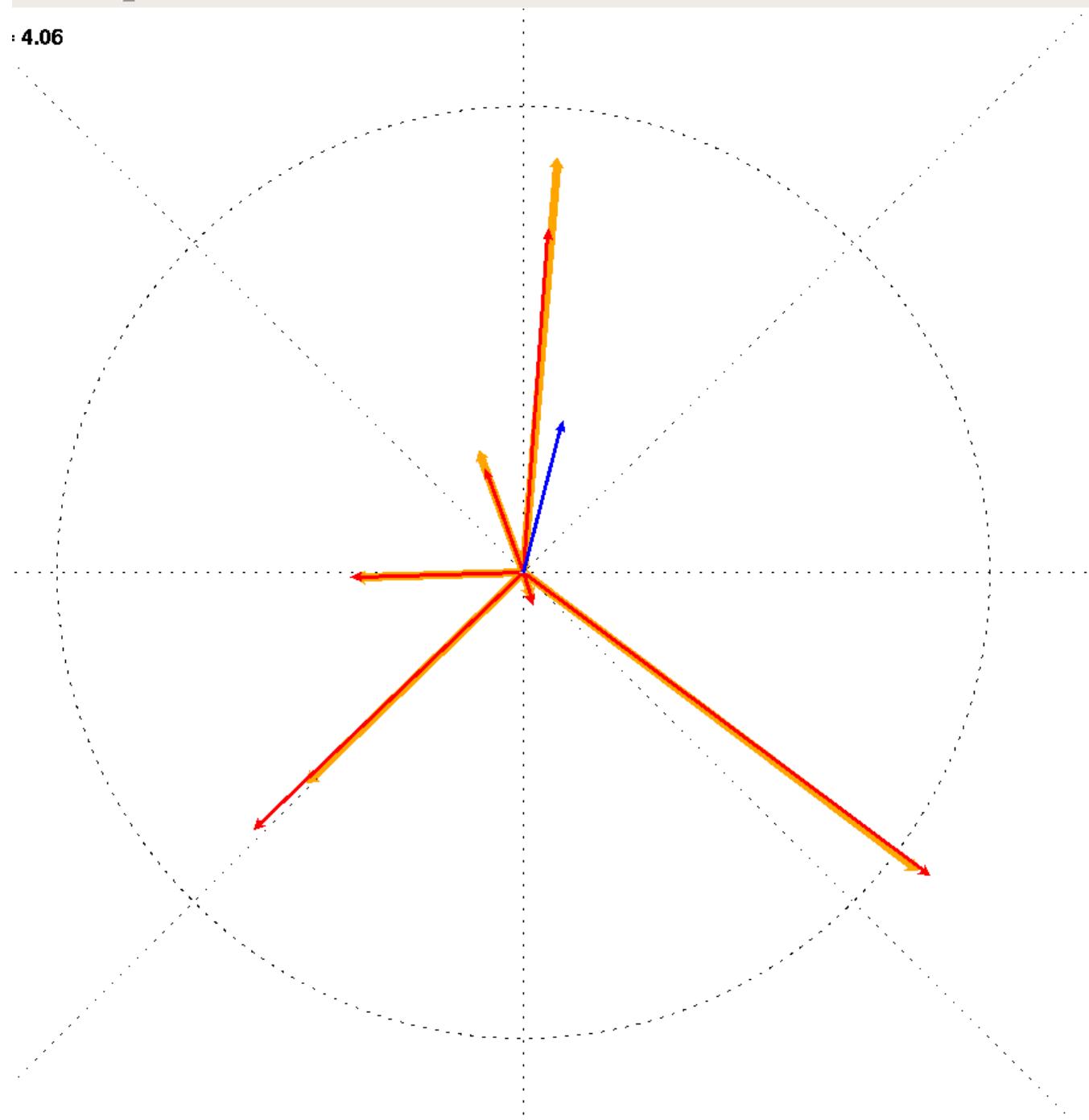
Gen. Jet	ET	Phi	Eta
895.0	-0.61	-0.87	
611.0	-2.29	1.66	
607.8	2.00	-0.50	
458.2	1.68	0.03	

Reco Jet	ET	Phi	Eta
992.4	-0.61	-0.87	
655.1	-2.29	1.69	
567.2	2.01	-0.49	
413.6	1.70	0.05	
50.2	-2.59	1.26	
25.1	1.08	-0.08	

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Show reco Show gen
 Show gen MET Show reco MET
 Gen vals Gen vals

4.06



Gen. Met
ET = 0.9 GeV phi = -0.80

Reco Met
ET = 168.7 GeV phi = 1.32
Uncorr Met
ET = 149.4 GeV phi = 1.47

Gen. Jet	ET	Phi	Eta
532.2	-0.65	-1.16	
447.9	1.49	-0.44	
325.5	-2.37	-0.22	
181.8	-3.11	-0.57	
140.4	1.92	0.53	
30.6	-1.26	3.56	

Reco Jet	ET	Phi	Eta
545.7	-0.64	-1.18	
400.8	-2.38	-0.27	
370.6	1.50	-0.48	
185.5	-3.12	-0.61	
119.7	1.92	0.48	
37.5	-1.28	3.52	

Prev Event

Next Event

Quit

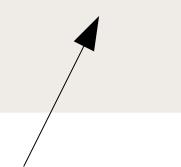
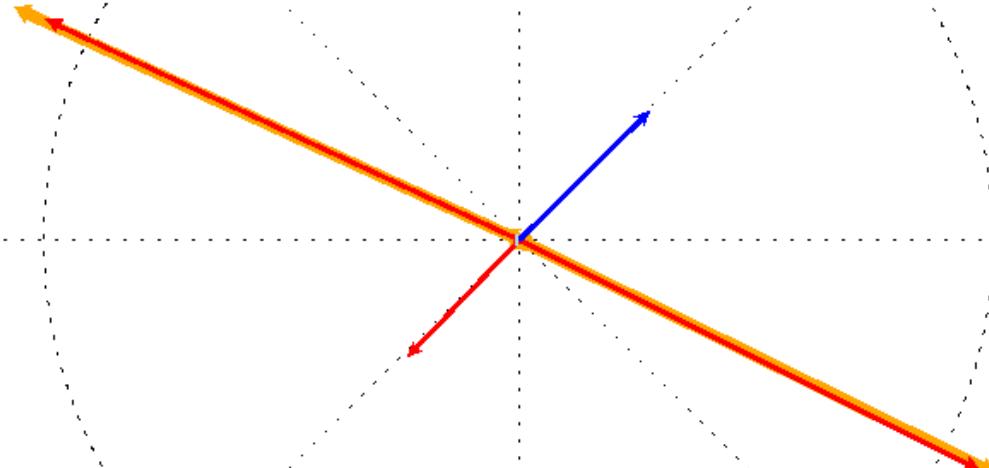
2 previously-shown events

- (1986, 48) had extra jet
- (8644, 27) had poorly-reco'd jet – seemed to be missing simHits for some particles associated with jet

- Show reco Show gen
- Show gen MET Show reco MET
- Reco vals Gen vals

Sig = 5.12

No bug found for (1986, 48)
(as expected?)



Gen. Met
ET = 2.7 GeV phi = -2.54

Reco Met
ET = 195.4 GeV phi = 0.77
Uncorr Met
ET = 165.4 GeV phi = 0.42

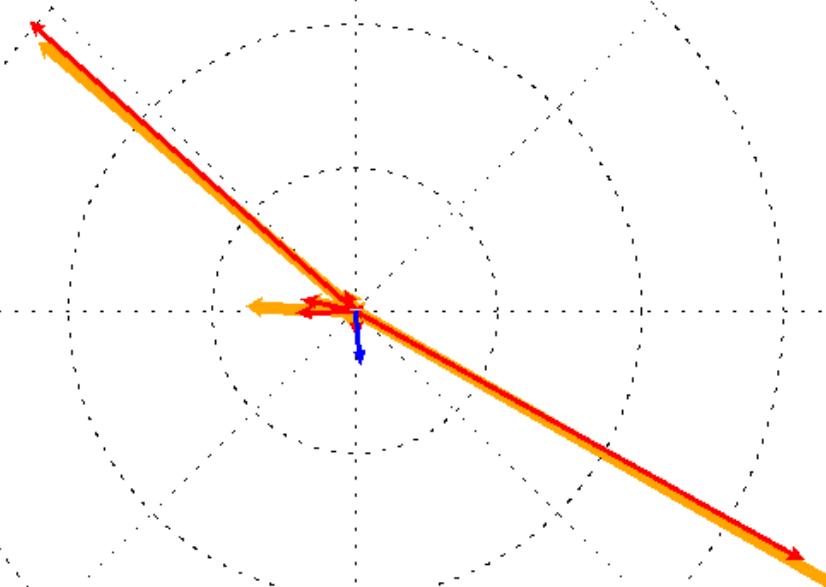
Gen. Jet	ET	Phi	Eta
584.5	2.71	2.24	
561.1	-0.46	0.37	
22.1	-0.31	1.56	
20.1	2.50	-2.91	
20.4	-0.72	-1.10	

Reco Jet	ET	Phi	Eta
548.7	2.71	2.25	
544.3	-0.47	0.36	
172.1	-2.32	1.02	

- Show reco Show gen
- Show gen MET Show reco MET
- Reco vals Gen vals

Sig = 3.13

BUG FOUND for 8644, 27!!



Gen. Met
ET = 0.8 GeV phi = 0.22

Reco Met
ET = 196.5 GeV phi = -1.46
Uncorr Met
ET = 145.0 GeV phi = -2.33

Gen. Jet	ET	Phi	Eta
1982.7	-0.52	-0.38	
1454.2	2.44	1.13	
382.8	3.11	0.85	
181.9	2.94	-0.31	
81.5	2.06	1.64	
80.9	-1.47	-1.42	
24.0	3.01	-1.52	

Reco Jet	ET	Phi	Eta
1798.8	-0.51	-0.35	
1527.0	2.42	1.16	
206.1	-3.10	0.97	
191.7	2.92	-0.26	
96.9	-1.48	-1.41	
82.2	2.04	1.69	
28.5	2.96	-1.51	

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Quit

What next

- Check over simTracks associated with each jet
- Set simTrack bug bool for each jet
- Look for correlations between my poorly-reco'd jets and bug boolean for the jet
- Look in more detail at MET events without bug